PIGEON SPRING G-E-M RESOURCES AREA (GRA NO. NV-20) TECHNICAL REPORT (WSA NV 050-0350)

Contract YA-553-RFP2-1054

Prepared By

Great Basin GEM Joint Venture
251 Ralston Street
Reno, Nevada 89503

For

Bureau of Land Management
Denver Service Center
Building 50, Mailroom
Denver Federal Center
Denver, Colorado 80295

Final Report

April 29, 1983

TABLE OF CONTENTS

Table of Contents cont.

Table of Contents cont.

Table of Contents cont.

Page

LIST OF ILLUSTRATIONS

ATTACHMENTS
(At End of Report)

EXECUTIVE SUMMARY

The Pigeon Spring Geology-Energy-Mineral (GEM) Resources Area (GRA) is 30 miles southwest of Goldfield, in Esmeralda County, Nevada. There is one Wilderness Study Area (WSA), NV 050-0350.

The sedimentary rocks in the GRA are all older than 400 million years, and they were extensively intruded by large granitic bodies about 200 million years ago. Widespread metallic mineralization and talc mineralization resulted from this period of mineralization. There are some areas of volcanic rocks about 15 million years old. In the small WSA the rock is mostly granite, with small areas of the sedimentary rocks and some of the young volcanic rocks.

More than 200,000 tons of talc have been produced from the Sylvania and Palmetto districts in the GRA just north of the WSA. Small tonnages of lead-zinc-silver ore have been produced from the Sylvania district. An unknown amount of gold has been produced from placer deposits in washes at several places in the GRA, including a short distance north of the WSA. There is a large area of disseminated molybdenum mineralization just east of the WSA that has been explored and tested by several mining companies in the past twenty years.

There are a few patented claims in the GRA, southwest of the WSA. There are hundreds of unpatented claims, mostly in the Nevada side of the GRA and concentrated in the vicinity of the molybdenum area and also in the talc-bearing area. There are a substantial number of placer claims. There are no oil and gas or geothermal leases in the GRA.

A small part of WSA NV 050-0350 is classified as highly favorable for placer gold deposits, with a moderate level of confidence, and a small part is classified as moderately favorable for molybdenum deposits with a high level of confidence. The remainder is classified as having no indication of favorability for metallic mineral resources but with the lowest level of confidence in this classification because of the closeness of many kinds of metallic mineral occurrences. The entire WSA is classified as having low favorability for uranium and thorium, with a low level of confidence. The entire WSA is classified as having low favorability for nonmetallic minerals, with low confidence in this classification. There is no indication of favorability with a high level of confidence for oil and gas. Geothermal resources have low favorability, with a low level of confidence. There is no indication of favorability for sodium and potassium resources, with a high level of confidence.

No additional work is recommendedd for WSA 050-0350.

I. INTRODUCTION

The Pigeon Spring G-E-M Resources Area (GRA No. NV-20) contains approximately 110,000 acres (450 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Pigeon Spring	NV 050-0350

The GRA is located in Nevada and California in the Bureau of Land Management's (BLM) Stateline/Esmeralda Resource Areas, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 37°18' north latitude, 117°45' west longitude and includes the following townships:

T 6 S, R 38, 39 E
T 7 S, R 38-40 E

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

15 minute:

Magruder Mountain

The nearest town is Dyer which is located about 30 miles northwest of the WSA. Access to the area is via Nevada State Route 3A to the northwest. Access within the area is via unimproved light duty and dirt roads throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic mmap of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the correspondding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range Province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

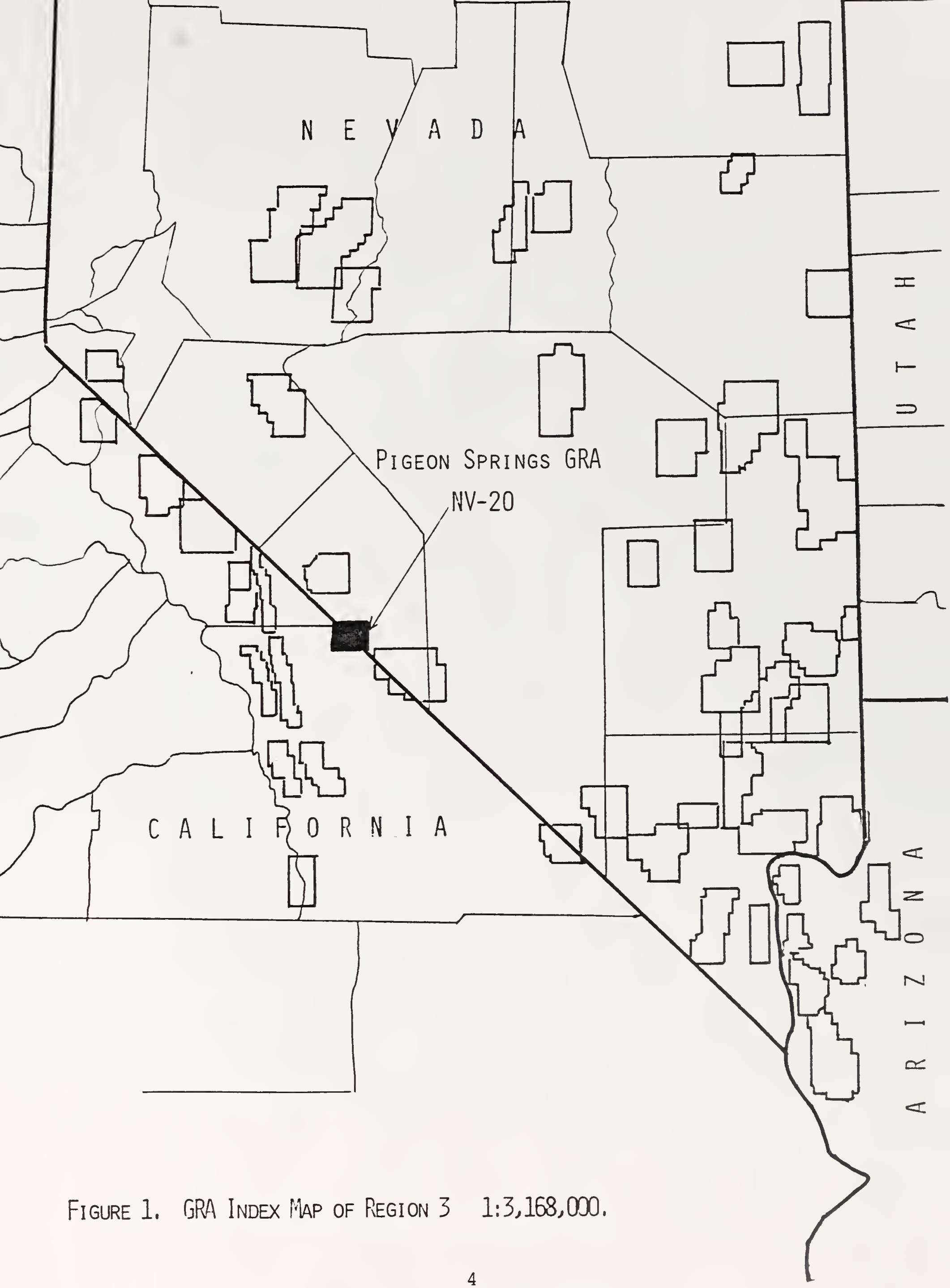
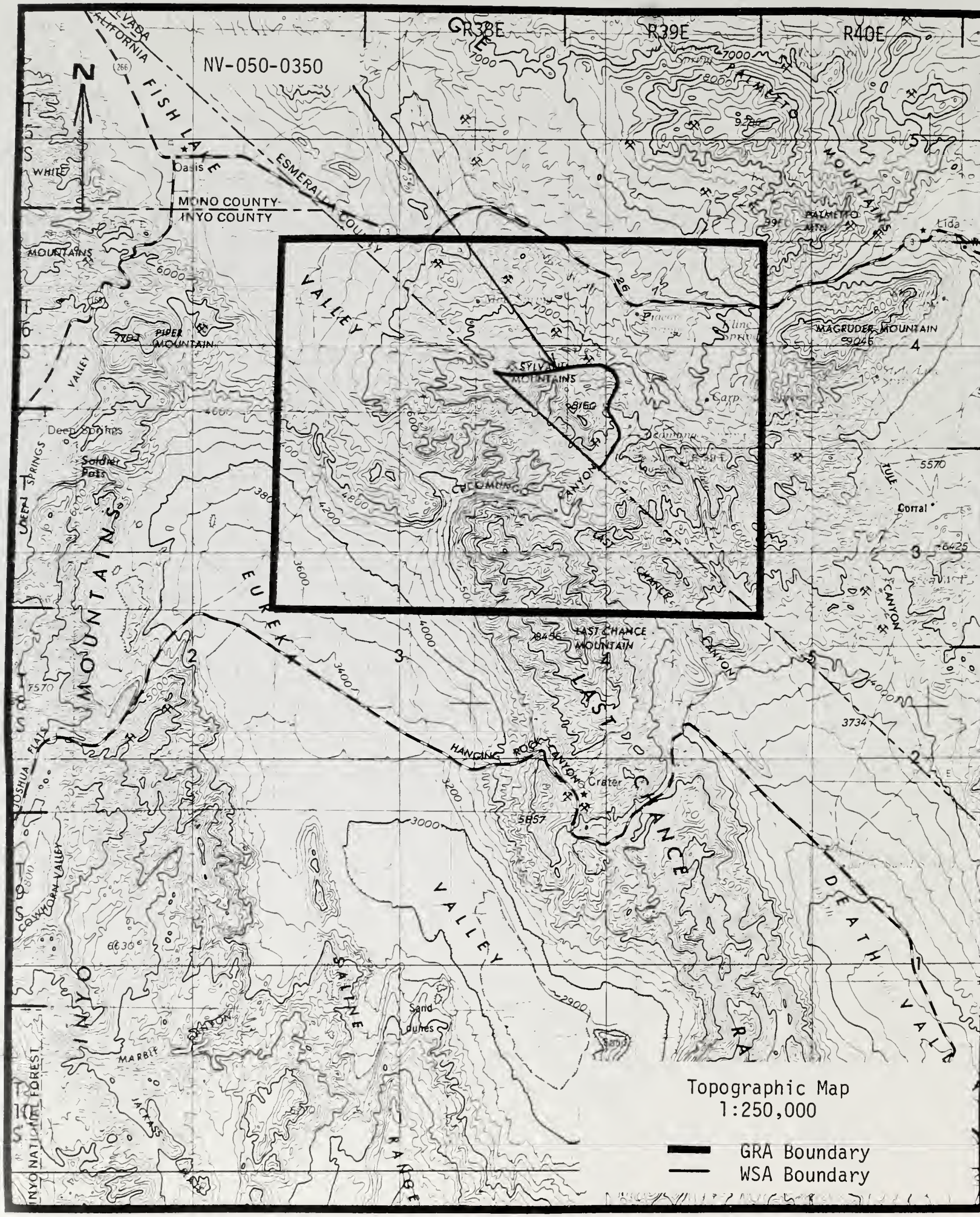


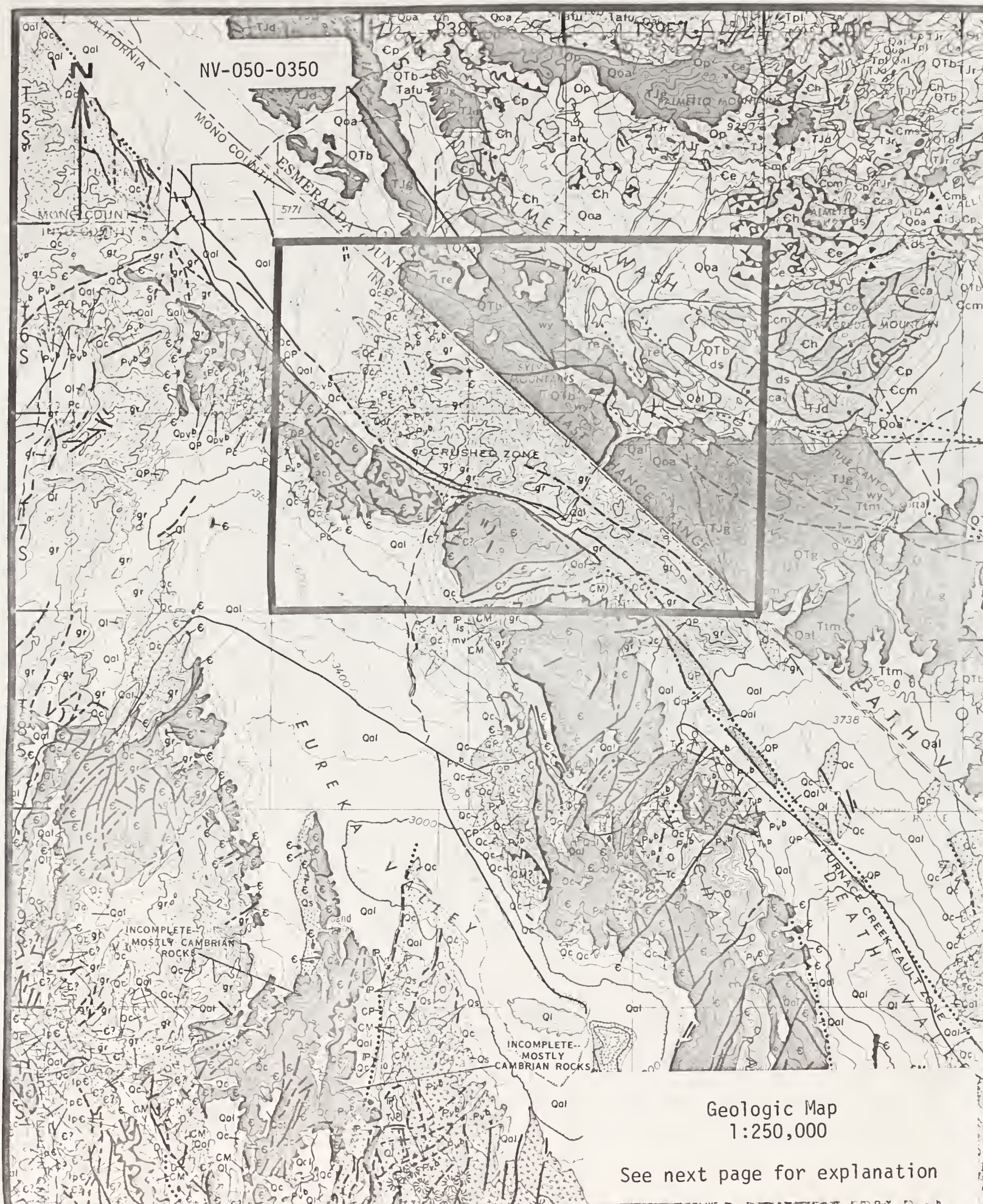
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Goldfield Sheet

Pigeon Spring GRA NV-20

Figure 2



Mariposa Sheet, Strand (1967);
Albers and Stewart, 1972

Pigeon Spring GRA NV-20
Figure 3

EXPLANATION

SEDIMENTARY AND METASEDIMENTARY ROCKS

CENOZOIC

QUATERNARY

Recent

- Qs — Dune sand
- Qal — Alluvium
- GREAT VALLEY:
  - Qsc — Stream channel deposits
  - Qf — Fan deposits
  - Qb — Basin deposits
- Qst — Salt deposits
- Ql — Quaternary lake deposits
- Qg — Glacial deposits
- Qt — Quaternary nonmarine terrace deposits

Pleistocene

- Qm — Pleistocene marine and marine terrace deposits
- Qc — Pleistocene nonmarine
- QP — Plio-Pleistocene nonmarine

TERTIARY

Pliocene

- Pc — Undivided Pliocene nonmarine
- Puc — Upper Pliocene nonmarine
- Pu — Upper Pliocene marine
- Pmlc — Middle and/or lower Pliocene nonmarine
- Pml — Middle and/or lower Pliocene marine

Miocene

- Mc — Undivided Miocene nonmarine
- Muc — Upper Miocene nonmarine
- Mu — Upper Miocene marine
- Mmc — Middle Miocene nonmarine
- Mm — Middle Miocene marine
- Ml — Lower Miocene marine

Oligocene

- Φc — Oligocene nonmarine
- Φ — Oligocene marine

Eocene

- Ec — Eocene nonmarine
- E — Eocene marine

Paleocene

- Epc — Paleocene nonmarine
- Ep — Paleocene marine

IGNEOUS AND META-IGNEOUS ROCKS

- Qrv — Recent volcanic: Qrv[r] —rhyolite; Qrv[a] —andesite; Qrv[b] —basalt; Qrv[p] —pyroclastic rocks
- Qpv — Pleistocene volcanic: Qpv[r] —rhyolite; Qpv[a] —andesite; Qpv[b] —basalt; Qpv[p] —pyroclastic rocks
- Quaternary and/or Pliocene cinder cones
- Pv — Pliocene volcanic: Pv[r] —rhyolite; Pv[a] —andesite; Pv[b] —basalt; Pv[p] —pyroclastic rocks
- Mv — Miocene volcanic: Mv[r] —rhyolite; Mv[a] —andesite; Mv[b] —basalt; Mv[p] —pyroclastic rocks
- Φv — Oligocene volcanic: Φv[r] —rhyolite; Φv[a] —andesite; Φv[b] —basalt; Φv[p] —pyroclastic rocks
- Ev — Eocene volcanic: Ev[r] —rhyolite; Ev[a] —andesite; Ev[b] —basalt; Ev[p] —pyroclastic rocks

EXPLANATION

Holocene

Qal — Desert wash, colluvium, alluvium, and playa deposits

Qp — Playa lake deposits

WHITE MOUNTAINS, VOLCANIC HILLS, NORTH END OF FISH LAKE VALLEY, MILLER MOUNTAIN, AND CANDELARIA HILLS

Qls — Landslide deposits

Qoa — Older alluvium
Chiefly gravel

Qm — Glacial moraine

QTb — Basalt

QTd — Diatomite

QTs — Weakly lithified sandstone and conglomerate

Tsu — Upper sedimentary unit
Shale, siltstone, sandstone, limestone, and conglomerate

Tr — Rhyolite plug or flow

Tofu — Upper nonwelded ash flow unit

Tql — Quartz latite

Tsl — Lower sedimentary unit
Mainly tuffaceous sedimentary rocks. Previously referred to as the Esmeralda Formation

Tpa — Porphyritic andesite

Tvb — Volcanic breccia of andesitic or dacitic composition

Taw — Welded ash flows
Age 22.8 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 14)

Tofl — Lower nonwelded ash flow
May include some airfall tuff

SILVER PEAK AND PALMETTO MOUNTAINS

Qls — Landslide deposits

Qoa — Older alluvium

QTs4 — Sedimentary unit 4
Weakly lithified conglomerate and tuffaceous rock

QTb — Basalt
Age 4.8 m.y. (million years) by K-Ar methods (Robinson and others, 1968, table 1, no. 7)

Ts3 — Sedimentary unit 3
Tuff, shale, limestone, and conglomerate

QTb — Upper welded ash flow
Age 6.1 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 5)

Tpb — Porphyritic basalt

Tpl / Ts — Porphyritic latite or trachyandesite
Tpl, porphyritic latite, K-Ar age is 5.9 m.y. (Robinson and others, 1968, no. 8). Ts, sedimentary rocks; sandstone, conglomerate, and tuff

Ta — Andesite
Probably in part intrusive

Tafu — Rhyolitic airfall tuff
Includes some rhyolitic lava flows and possibly some nonwelded ash flows. K-Ar age 6.0 m.y. (Robinson and others, 1968, table 1, no. 6)

Tr — Rhyolitic flows, domes, breccias, and intrusive masses

Ts2 — Sedimentary unit 2 and welded ash flow
Ts2, Tuffaceous shale and sandstone. Age 12.7 m.y. by K-Ar method (Evernden and James, 1964). Tsa2, Welded ash flow

Tvb — Volcanic breccia
Andesitic and dacitic(?) in composition

Ts1 — Sedimentary unit 1

Taw — Lower welded ash flow
Age 21.5 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 13)

Tof — Lower nonwelded ash flow

WEEPAH HILLS, LONE MOUNTAIN, ANGEL ISLAND, AND NORTHEASTERN PART OF CLAYTON VALLEY

Qb — Basalt

Qoa — Older alluvium
Chiefly gravel

QTb — Basalt

Tr — Rhyolite plug or flow

Ts / Te / Taf — Esmeralda Formation and ash-flow deposits
Ts, Shale, siltstone, sandstone, and tuff. Te, Esmeralda Formation, shale, sandstone, and tuff. Includes some beds as young as 6.9 m.y. (Robinson and others, 1968, table 1, no. 12). Taf, ash flow tuff

Taw — Welded ash flow

MONTE CRISTO RANGE AND CEDAR MOUNTAINS

Qoa — Older alluvium
Chiefly gravel

QTb — Basalt

Tg — Gilbert Andesite
An apparent anomalously old date of 15.1 m.y. was obtained from the Gilbert Andesite (table 3, this report)

Tr — Rhyolite plugs, domes, and flows

Ts — Shale, siltstone, sandstone, limestone, and tuff
Formerly referred to as Esmeralda Formation. Correlative rocks a few miles north of Esmeralda County are 10.7 and 11.5 m.y. old by K-Ar method (Evernden and others, 1964, p. 177, 180)

Trb — Rhyolite breccia
Locally grades into welded ash flows, includes lower part of Esmeralda Formation of Ferguson and others (1953)

Taw — Rhyolitic to quartz latitic welded ash flows

Tac — Nonwelded ash flow

TONOPAH AREA

Qoa — Older alluvium
Chiefly gravel

QTb — Basalt
Olivine basalt

Tql — Quartz latite and felsite
Includes Brougher Dacite. Age 18.2 m.y. by K-Ar method (table 3, this report)

Ta — Andesite
Includes Divide Andesite

To — Oddie(?) Rhyolite

Ts — Siebert Tuff
Tuff, tuffaceous shale, and diatomite; locally includes some sandstone and conglomerate

Tfb — Fraction Breccia
Ash flows of dominantly rhyolitic composition. Correlated with rocks in Nye County which are dated at 11.5 m.y. by K-Ar method

Taf — Welded and nonwelded ash flows

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

Ql — Landslide deposits

Qs — Bedded clay and silt

QTb / QTmr — Malpais Basalt and Rabbit Spring Formation
QTb, basalt. QTmr, Malpais Basalt and Rabbit Spring Formation

Ttc — Thirsty Canyon Tuff
Spearhead Member in Nye County has K-Ar age of 7.5 m.y. (Noble and others, 1964, p. D25)

Tdr — Dark rhyolite or rhyodacite
Dominantly agglutinate

Tp — Pozo Formation
Dominantly conglomerate and subordinate sandstone, poorly consolidated

Tsc — Conglomerate and sandstone
Possibly correlative with Pozo Formation

Tr — Rhyolite plugs, domes, and flows

Tpl — Porphyritic latite or trachyandesite

Tmi / Ts — Siebert Tuff and Mira Basalt
Ts, Siebert Tuff, dominantly tuffaceous sedimentary rocks of lacustrine origin. Tmi, Mira Basalt: flow intertongues with Siebert Tuff

Airfall tuff and tuffaceous shale
Tat, airfall tuff and tuff breccia of rhyolitic composition. Tas, tuffaceous shale and intertonguing airfall tuff. Ta, andesite

Tc — Chispa Andesite

Tew — Welded ash flows
Includes Meda Rhyolite and dacite vitrophyre of Ransome (1909). Age 21.1 m.y. by K-Ar method (this report, table 3)

Td — Dacite
Age 20.8 to 21.8 m.y. by K-Ar method (this report, table 3)

Tm — Milltown Andesite
Age 21.3 m.y. by K-Ar method (this report, table 3)

Tss — Sandstorm Formation

SLATE RIDGE AND SOUTHERN END OF COUNTY

QTb — Basalt

QTg — Weakly consolidated gravel and sand

Ttc — Thirsty Canyon Tuff
In map area includes only Spearhead and Trail Ridge Members. Spearhead Member in Nye County has K-Ar age of 7.5 m.y. (Noble and others, 1964, p. D25)

Td — Dacite

Ttm — Ammonia Tanks Member of Timber Mountain Tuff
Welded ash flows. Ammonia Tanks Member in Nye County is 10.5 to 11.5 m.y. old by K-Ar methods (R. W. Kistler, written communication, 1963)

Taf — Airfall tuff and nonwelded ash flows
May include lower part of Ammonia Tanks Member of Timber Mountain Tuff

Age divisions (left margin): Holocene; Pleistocene or Holocene; Pliocene or Pleistocene; Pliocene; Miocene

System divisions (right margin): QUATERNARY; TERTIARY OR QUATERNARY; TERTIARY *mation of Ferguson and others (1953)*

County which are dated at 17.5 m.y by K-Ar method

Chispa Andesite

Tew
Welded ash flow

Tew
Rhyolitic to quartz latitic welded ash flows

Tac
Nonwelded ash flow

Tew
Welded ash flows
Includes Meda Rhyolite and dacite vitrophyre of Ransome (1909)
Age 21.1 m.y by K-Ar method (this report, table 3)

Td
Dacite
Age 20.8 to 21.6 m.y by K-Ar method (this report, table 3)

Tm
Milltown Andesite
Age 21.5 m.y by K-Ar method (this report, table 3)

Tew
Welded ash flows
Age 22.8 m.y by K-Ar method (Robinson and others, 1968, table 1, no. 14)

Taf
Lower nonwelded ash flow
May include some airfall tuff

Tew
Lower welded ash flow
Age 21.5 m.y by K-Ar method (Robinson and others, 1968, table 1, no. 12)

Taf
Lower nonwelded ash flow

Oligocene or Miocene

Tss
Sandstorm Formation

Tk
Kendall Tuff and latite of Ransome (1909a)

Tv
Vindicator Rhyolite
Includes Morena Rhyolite of Ransome (1909a)

PRE-TERTIARY SEQUENCE APPLIES TO ENTIRE COUNTY EXCEPT MILLER MOUNTAIN AND GRAPEVINE MOUNTAINS AS NOTED BELOW

UNCONFORMITY

Dark aphanitic to medium-grained rocks of dioritic to andesitic composition

Felsic aphanitic rhyolite and quartz porphyry dike rocks

Coarse-grained granitic rocks
Mainly biotite quartz monzonite but includes some granodiorite and monzonite. Also includes pegmatitic material in Mineral Ridge area

JURASSIC TO TERTIARY

Lower and Middle Jurassic

Jd
Dunlap Formation
Red sandstone containing lenses of conglomerate and red shale

JURASSIC

UNCONFORMITY

Middle Triassic(?)

Excelsior Formation

TRIASSIC(?)

UNCONFORMITY(?)

Lower Triassic

Candelaria Formation
Shale and sandstone

TRIASSIC

UNCONFORMITY

Pd
Diablo Formation
Dolomite, grit, and conglomerate

PERMIAN

GRAPEVINE MOUNTAINS

Shaly rocks
Contains impure carbonate lenses with Mississippian fossils

MISSISSIPPIAN

FAULT

Pogonip Group
Thin-bedded limestone with shaly interbeds

ORDOVICIAN

UNCONFORMITY(?)

Nopah Formation
Gray thick-bedded dolomite

UNCONFORMITY

Op
Palmetto Formation
Dominantly black shale; locally contains abundant chert, limestone, and quartzite

Upper Cambrian

Middle and Upper Cambrian

MILLER MOUNTAIN AREA

Lower and Middle(?) Cambrian

Csh
Siliceous hornfels

Lower Cambrian

Cm
Marble
Possibly correlative with Mule Spring Limestone

Ch(?)
Harkless(?) Formation

Poleta(?) Formation
Siliceous and calc-silicate hornfels interbanded with marble

Campito Formation
Metamorphosed siltstone and quartzite

Ce
Emigrant Formation
Mostly claystone in lower part, overlain by thin-bedded limestone with cherty layers

Cms
Mule Spring Limestone

Ch
Harkless Formation
Dominantly green siltstone, locally includes strata lithologically similar to and correlative with Saline Valley Formation as defined by Nelson (1962)

Poleta Formation
Mostly thick-bedded carbonate in lower part, overlain by green siltstone with limestone and quartzite interbeds

Ccm / Cca
Campito Formation
Ccm, Montenegro Member, dominantly green siltstone
Cca, Andrews Mountain Member, dominantly dark-gray fine-grained quartzite

CAMBRIAN

ds
Deep Spring Formation
Dominantly well-bedded limestone and dolomite, subordinate dark quartzite

Reed Dolomite

Wy
Wyman Formation
Dominantly siltstone containing thin limestone interbeds

PRECAMBRIAN

Contact

High-angle fault
Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side. Queried where doubtful

Low-angle fault or thrust
Dotted where concealed. Sawteeth on upper plate

Anticline
Showing crestline

Syncline
Showing troughline

Note: The Esmeralda Formation is herein restricted to include only the predominantly sedimentary upper unit as mapped by Ferguson and others (1953), and to exclude the Fraction Breccia from its lower part. The Spearhead was reduced in rank to a member of the Thirsty Canyon Tuff by Noble and others (1964)

Geology mapped 1960-6

GEOLOGIC MAP OF ESMERALDA COUNTY, NEVADA

By
John P. Albers and John H. Stewart

SCALE 1:250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 KILOMETERS

CONTOUR INTERVALS 100 AND 200 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION CONT.

Paleocene

- Ep — Paleocene marine

Undivided

- CT — Cenozoic nonmarine
- Tc — Tertiary nonmarine
- Tl — Tertiary lake deposits
- Tm — Tertiary marine

- CTv — Cenozoic volcanic: CTv' —rhyolite; CTv° —andesite; CTv^b —basalt; CTv^p —pyroclastic rocks
- Tgr — Tertiary granitic rocks
- Ti — Tertiary intrusive (hypabyssal) rocks: Ti' —rhyolite; Ti° —andesite; Ti^b —basalt
- Tv — Tertiary volcanic: Tv' —rhyolite; Tv° —andesite; Tv^b —basalt; Tv^p —pyroclastic rocks

MESOZOIC

CRETACEOUS

- K — Undivided Cretaceous marine
- Ku — Upper Cretaceous marine
- Kl — Lower Cretaceous marine

JURASSIC

- Jk — Knoxville Formation
- Ju — Upper Jurassic marine
- Jml — Middle and/or Lower Jurassic marine

TRIASSIC

- Ŧ — Triassic marine

Franciscan Formation

- KJf — Franciscan Formation
- KJfv — Franciscan volcanic and metavolcanic rocks
- gr — Mesozoic granitic rocks: gr^g —granite and adamellite; gr^gd —granodiorite; gr^t —tonalite and diorite
- bi — Mesozoic basic intrusive rocks
- ub — Mesozoic ultrabasic intrusive rocks
- JŦv — Jura-Trias metavolcanic rocks

UNDIVIDED

- m / ls — Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)
- ms — Pre-Cretaceous metasedimentary rocks
- P / ls — Paleozoic marine (ls = limestone or dolomite)

- mv — Pre-Cretaceous metavolcanic rocks
- gr-m — Pre-Cenozoic granitic and metamorphic rocks
- Pv — Paleozoic metavolcanic rocks

PALEOZOIC

PERMIAN

- P — Permian marine
- Pv — Permian metavolcanic rocks

CARBONIFEROUS

- C — Undivided Carboniferous marine
- CP — Pennsylvanian marine
- CM — Mississippian marine
- Cv — Carboniferous metavolcanic rocks

DEVONIAN

- D — Devonian marine
- Dv — Devonian metavolcanic rocks
- Dv? — Devonian and pre-Devonian? metavolcanic rocks

SILURIAN

- S — Silurian marine

ORDOVICIAN

- pSs — Pre-Silurian metasedimentary rocks
- pS — Pre-Silurian metamorphic rocks
- pSv — Pre-Silurian metavolcanic rocks
- O — Ordovician marine

CAMBRIAN

- Є — Cambrian marine
- Є? — Cambrian – Precambrian marine

PRECAMBRIAN

- pЄc — Precambrian igneous and metamorphic rock complex
- pЄ — Undivided Precambrian metamorphic rocks: pЄg = gneiss, pЄs = schist
- pЄgr — Undivided Precambrian granitic rocks
- lpЄ — Later Precambrian sedimentary and metamorphic rocks
- pЄan — Precambrian anorthosite
- epЄ — Earlier Precambrian metamorphic rocks

II. GEOLOGY

The Pigeon Spring GRA lies across the California-Nevada border, and the southwest side of WSA NV 050-0350 is defined by the border. The WSA includes the highest parts of the Sylvania Mountains, and most of it is steep and rugged.

In most of the WSA the bedrock is Jurassic quartz monzonite, which is intruded into a thick series of Precambrian to Paleozoic sediments. In the WSA the only sediments are small areas of hornfels Wyman Formation and recrystallized Reed Dolomite. These two Precambrian formations are the oldest in the sedimentary series. A narrow band of Tertiary olivine basalt lies across part of the WSA, on the sediments and quartz monzonite.

The sediments in the WSA are too metamorphosed and too small in area to display folding, but they probably have been folded along axes that trend west-northwest. Major high-angle faults are projected into the WSA from several miles to the east, but cannot be identified with certainty in the WSA. A couple of miles west of the WSA is the Furnace Creek fault zone, a major right-lateral fault with intense crushing adjacent to it near the WSA.

1. PHYSIOGRAPHY

The Pigeon Spring GRA lies in Esmeralda County, Nevada and Inyo County, California. It covers much of the divide between the north end of Death Valley and the south end of Fish Lake Valley. Cucomongo Canyon drains the south part of the GRA, flowing west to empty into Eureka Valley. Palmetto Wash drains the northern part of the GRA, emptying into Fish Lake Valley. The extreme eastern part of the GRA drains through Tule Canyon into Death Valley.

Eureka Valley and Death Valley south and west of the GRA have elevations somewhat under 4,000 feet in and near the GRA, although Death Valley drops to below sea level farther south. Fish Lake Valley to the west of the GRA and the unnamed broad valley east of the GRA have elevations of about 5,000 feet. The Sylvania Mountains in the middle of the GRA attain a maximum elevation of 8,160 feet in about the middle of WSA NV 050-0350. The higher elevations are forested with pinon, but elevations below about 6,500 feet have typical desert growths. Much of the country in the GRA is fairly flat or gently rolling, but much is steep and rugged. Most of the WSA NV 050-0350 falls into the latter category.

2. ROCK UNITS

The oldest rocks in the GRA are a series of conformable sedimentary formations, the earliest deposited in Late Precambrian, the youngest in Ordovician. Only the older two of these units, both of them Precambrian, have a bearing on WSA NV 050-0350, and only these units will be described here. The descriptions are taken from Albers and Stewart (1972).

The oldest unit is the Wyman Formation, dominantly siltstone with thin limestone interbeds. The bottom of this unit is not seen anywhere in the region. In the WSA the formation is hornfelsed everywhere. Overlying the Wyman is the Reed Dolomite, which may be as much as 1,700 feet thick, but only small outcrop areas of it are seen in the WSA and in all of these the Formation is recrystallized. The Reed Dolomite is the host for talc deposits in the northern part of the GRA, outside the WSA.

In and around the WSA the Precambrian and Paleozoic sediments have been intruded by the Jurassic Sylvania pluton, a large, generally west-northwest-trending body of quartz monzonite composition. Albers and Stewart (1972) speculate that this pluton and adjacent ones are simply the upper parts of what at depth is a single very large intrusive body.

There are few Tertiary rocks in the GRA, and in the WSA the only one is a band of olivine basalt that overlies the Precambrian sediments and the Jurassic intrusive.

A narrow band of Quaternary alluvium occupies Cucomungo Wash at the south and east edges of the WSA.

3. STRUCTURAL GEOLOGY AND TECTONICS

The northwest-trending Furnace Creek fault zone which parallels the California-Nevada state line, passes about three miles west of WSA NV 050-0350. It makes a rather pronounced bend just west of the WSA, and the rocks for a mile or more on the east side of it are notably crushed (Strand, 1967). Much of the movement on this fault is right-lateral strike slip, and much of it has taken place during the Tertiary.

Albers and Stewart (1972) project two major high-angle arcuate faults from several miles east of the WSA into the WSA.

No folding of the sediments is mapped in or near the WSA, but presumably before intrusion the sediments were folded with west-northwest axial trends -- according to the folding pattern Albers and Stewart (1972) apply to this region.

4. PALEONTOLOGY

The assemblage of lithologies within the Pigeon Spring GRA is unfavorable for the preservation of paleontological resources except for isolated blocks of the Palmetto formation (Ordovician) and Late Precambrian - Early Cambrian rocks including the (?)Campito, Reed Dolomite and Wyman formations or their equivalents. No fossil localities have been recorded from this area, although elsewhere these units are fossiliferous (Nelson, 1978).

5. HISTORICAL GEOLOGY

Beginning in Late Precambrian and lasting until at least Ordovician, sediments were deposited in shallow seas in this region, which was close to the boundary between the western clastic facies and the eastern carbonate facies (Albers and Stewart, 1972). At some time after the Ordovician, but before the Jurassic, the sediments were folded; and in the Jurassic large igneous bodies of generally quartz monzonite composition were intruded. To a considerable extent the intrusions were guided along the direction of fold axes. Mineralization accompanied the intrusions. Later, perhaps in conjunction with initiation of large-scale right-lateral faulting, the folds were refolded into what Albers (1967) terms "oroflexes". Much later, after extensive erosion, Tertiary tuffs and olivine basalt flows were deposited and, in their turn, mostly eroded from the GRA.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

Just north of WSA NV 050-0350 is the Sylvania mine and several prospects. The Sylvania mine has produced lead-silver ore from deposits at the contact between the Wyman Formation and the Jurassic intrusive. The boundary of the WSA is drawn so it excludes this contact.

The wash that runs due north through Secs. 19, 18 and 7, T 6 S, R 39 E (Magruder Mountain 15-minute topographic quadrangle) has been placer-mined for gold along its entire length from half a mile north of the WSA to its mouth (Arthur Baker III, personal communication). Other washes in the GRA have also been placered.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

East of the WSA is the Cucomungo molybdenum prospect, a large area of complex intrusions and alteration in which extensive low-grade molybdenum is known (Briner, 1980). The alteration and mineralization are not known to extend into the WSA.

In the WSA about 1.5 km southwest of Cucomungo Spring, is the Les Brown molybdenum prospect (Briner, 1980). It appears on the McGruder Mountain 15-minute topographic quadrangle as several prospect symbols just north of Cucomungo Wash, and Albers and Stewart (1972) show it as a mine symbol rather than a prospect.

3. Mining Claims

There are patented claims north of WSA NV 050-0350, probably at the Sylvania mine, and south of the WSA, mostly in California in T 7 S, R 39 E in an area where no mines or prospects are known (Norman and Stewart, 1951).

The area around the WSA is densely staked. North of the WSA the staking is partly along the contact on which the Sylvania mine lies, but probably most of the claims were located for talc. East, southeast and south of the WSA the claims cover the Cucomungo mineralized area and its presumed extension under Tertiary cover to the north.

The pattern of dense staking extends into the northeast corner of the WSA in Secs. 29 and 30, T 6 S, R 39 E. Most of the claims within the WSA are placer claims.

4. Mineral Deposit Types

The Sylvania mine, just north of the GRA, has ore in small replacement bodies and perhaps some veins in carbonaceous units of the Wyman Formation in a small septum within the Sylvania pluton. Similar mineralization is not known within the WSA.

The Cucomungo molybdenum mineralization occurs in a stockwork in a very complex system of several intrusive bodies that are all of about the same age and origin. They are Jurassic like the other intrusive bodies in the area. Molybdenum minerals are disseminated in the igneous rocks (Briner, 1980). The mineralization is not known to extend westward into the WSA.

The Les Brown molybdenite prospect, which is within the WSA, is in a pegmatite body intruded into the Sylvania pluton.

Placer gold has been mined at a number of places in the GRA, most notably in the canyon north of WSA NV 050-0350 and in Tule Canyon at and beyond the east edge of the GRA. The source of the gold has been a matter for speculation by prospectors for many years, as there are no local deposits that appear capable of producing the relatively large amount of gold that has been found, and much of the gold is worn and rounded as though it has been transported a long distance (Arthur Baker III, personal communication).

5. Mineral Economics

The Sylvania mine occurrences are small, probably submarginal in the marketing situation for lead-silver ores in the early 1980s.

The Cucomungo molybdenum mineralization is very extensive, and if a body of sufficient size and grade can be found, undoubtedly it can be mined open pit. The critical need is that both grade and tonnage be high enough to justify a very large and expensive plant.

The Les Brown molybdenite prospect, being in a pegmatite dike, almost certainly is too small to be of current interest.

The placer gold deposits in the GRA are small, confined to narrow wash bottoms, and can only be worked seasonally because of the lack of water.

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

The major uses of silver are in photographic film, sterlingware, and increasingly in electrical contacts and conductors. It is also widely used for storage of wealth in the form of jewelry, "coins" or bullion. Like gold it is commonly measured in troy ounces, which weigh 31.1 grand grams, twelve of which make one troy pound. World production is about 350 million ounces per year, of which the United States produces about one-tenth, while it uses more than one-third of world production. About two-thirds of all silver is produced as a byproduct in the mining of other metals, so the supply cannot readily adjust to demand. It is a strategic metal. Demand is expected to increase in the next decades because of growing industrial use. At the end of 1982 the price of silver was $11.70 per ounce.

The largest use for lead is in electrical storage batteries, the second being a gasoline antiknock additive. It has many other uses, however, including radiation shielding, solders, numerous chemical applications and in construction. About four million metric tons of lead are produced in the world annually. The United States produces about half a million tons per year, and recovers about the same amount from scrap -- much of it through the recycling of old batteries. It imports about one-quarter of a million tons. Lead is classified as a strategic mineral. Demand is projected to increase somewhat in the next couple of decades, but environmental concerns will limit the increase. The United States has large ore reserves that are expected to last well beyond the end of this century at current production rates even without major new discoveries. At the end of 1982 the price was about 22 cents per pound.

About 70 percent of molybdenum is used in alloy steels where it improves hardenability and toughness, as well as resistance to corrosion and abrasion. Some is used by itself as a refractory metal, and the remainder is used in chemical and other nonmetallurgical applications. The United States uses about 70 million pounds annually, while producing more than 125 million pounds. The rest of the world produces only about 90 million pounds, so the United States is by far the world's largest supplier of molybdenum. For many years the Climax deposit in Colorado alone supplied most of the world's molybdenum, with the remainder coming mostly as a byproduct of large-scale copper mining. In recent years several large deposits have been found in the United States in which molybdenum is the principal metal, and these, with by-product production, are expected to be ample to meet United States demand well through the year 2000. In late 1982 the price of molybdenum in the form of molybdenite, molybdenum sulfide -- the mineral that is the usual F.O.B. mine product -- was $7.90 per pound.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

More than 200,000 tons of talc and chloritic talc have been produced from the Sylvania district just north of WSA NV 050-0350, and from the Palmetto district a few miles farther north. No talc deposits are known within the WSA (Papke, 1975).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Prospects on talc and chloritic talc occurrences in the Sylvania district are numerous, and a few of these lie only a short distance north of the WSA but none are known within the WSA (Papke, 1975).

About one mile east of the WSA is the Amry fluorite prospect, in the southeast quarter of Sec. 33, T 6, S, R 39 E (Papke, 1979).

No nonmetallic prospects, occurrences or mineralized areas are known in the WSA.

3. Mining Claims, Leases and Material Sites

No claims for nonmetallic minerals have been identified within the WSA. There are no leases and no material sites in the WSA.

4. Mineral Deposit Types

The talc ore bodies for the most part are in dolomite or limestone. Talc also occurs in hornfels but rarely in igneous rocks. Most of the Sylvania district talc bodies are in dolomite near intrusive contacts, usually along faults and usually podlike with their long axes trending northwest. The Reed Dolomite is the most common host rock, but some deposits occur in the Wyman Formation (Papke, 1975).

The Amry fluorite deposit is a tabular body up to four feet wide and 70 feet long, conformable to bedding in a tactite mass (Papke, 1979).

5. Mineral Economics

The talc deposits of the Sylvania and Palmetto districts are relatively small -- none are known to have produced more than 100,000 tons of ore. All of the known deposits of any size are worked out. Larger deposits at other places have largely taken over the talc market.

The Amry fluorite deposit, as described, is very small and the grade is such that the ore would have to be processed to make a saleable product. The deposit itself is much too small to support a mill, and no other deposits are known in the region that might contribute to mill feed. Therefore it is not likely that it can be worked.

Talc and pyrophyllite are two different minerals, but have somewhat similar chemical compositions and physical characteristics, so they can be used interchangeably in some applications, but also each of them has applications in which it is more suitable than the other. Most available economic data treat the two minerals (and small amounts of others) together, so they are treated this way here and the term talc is used to include all the talc-like minerals. About one-fourth of all talc is used in ceramics, with a somewhat smaller portion used in paint and a still smaller portion in plastics as a filler; these three uses account for about two-thirds of talc consumption. The most well-known use, in talcum powder and other cosmetics, uses only about seven percent of total consumption. Pyrophyllite as such is particularly heavily used in insecticides and refractories. United States consumption of talc is about one million short tons per year and production is about 1.3 million tons per year with the overage being exported. Talc consumption is forecast to about double by the year 2000, with domestic production increasing enough to keep up with demand but exports probably ceasing. The price of crude talc as mined is about $15 per ton, while processed talc sold by producers (principally ground), is about $65 per ton.

By far the greatest use of fluorite (or fluorspar) is in the production of hydrofluoric acid, which has many industrial applications. Other uses are in steelmaking, welding rods, refining of a number of metals, and in the production of certain glasses. World production of fluorine, the principal component of fluorite, is about 2.5 million tons annually, of which the United States produces less than 100 thousand tons, nearly half of this being in the form of fluorosilicic acid that is a byproduct of phosphate production. United States consumption is about 700 thousand tons annually, with more than half of the shortfall imported from Mexico and the remainder mostly from South Africa, Spain and Italy. Fluorite is a strategic and critical mineral. United States demand for fluorite is expected to increase by about 50% by the year 2000, and probably all of the increase will be imported. In 1980 the price of fluorite was about $65 to $85 per ton, depending upon the quality.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

   There are no known uranium or thorium deposits in the WSA or the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

   There are no known uranium or thorium occurrences in the GRA. However, there are several occurrences to the east of the GRA (see Uranium Land Classification Occurrence Map). These occurrrences are either in quartz monzonite or the Precambrian Wyman Formation, and the radioactivity is usually concentrated along shear zones, pegmatite dikes or quartz veins, and is often associated with oxidized copper and iron minerals (Garside, 1973). The occurrences closest to the GRA are tabulated below:

Name	Location	Occurrence
Old Ingalls mine	T 7 S, R 40 E - Tule Canyon Area	The presence of uranium in the mine is reported

Tule Canyon placers	T 7 S, R 40 E	Uranothorite, monazite, xenotime and euxenite reported from heavy mineral fraction of gravel
Tule Royal group (Nos. 1-6)	T 8 S, R 41 E - East side Tule Canyon	Anomalous radio-activity associated with limonitic patches in granite, adjacent to a two-foot wide quartz vein.
Name unknown	SW 1/4 Sec. 23 NW 1/4 Sec. 26, T 8 S, R 40 E	Autunite occurs along a fault in shale of the Wyman Fm.

3. Mining Claims, Leases and Material Sites

There are no known uranium or thorium claims or leases in the GRA.

4. Deposit Types

Deposit types cannot be discussed due to the lack of uranium or thorium occurrences in the GRA.

5. Mineral Economics

Uranium and thorium appear to be of little economic value in the GRA due to the lack of deposits of these elements.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 56,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current andd future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Thorium is used in the manufacture of incandescent gas mantles, welding rods, refractories, as fuel for nuclear power reactors and as an alloying agent. The principal source of thorium is monazite which is recovered as a by-porduct of titanium, zirconium and rare earth recovery from beach sands. Although monazite is produced from Florida beach sands, thorium products are not produced from monazite in the United States. Consequently, thorium products used in the United States come from imports, primarily from France and Canada, and industry and government stocks. Estimated United States consumption of thorium in 1980 was 33 tons, most of which was used in incandescent lamp mantles and refractories (Kirk, 1980b). Use of thorium as nuclear fuel is relatively small at present, because only two commercial thorium-fueled reactors are in operation. Annual United States demand for thorium is projected at 155 tons by 2000 (Kirk, 1980a). Most of this growth is forecast to occur in nuclear power reactor usage, assuming that six to ten thorium-fueled reactors are on line by that time. The United States and the rest of the world are in a favorable position with regard to adequacy of thorium reserves. The United States has reserves estimated at 218,000 tons of ThO_2 in stream and beach placers, veins and carbonatite deposits (Kirk, 1982); and probable cumulative demand in the United States as of 2000 is estimated at only 1,800 tons (Kirk, 1980b). The price of thorium oxide at the end of 1981 was $16.45 per pound.

Oil and Gas Resources

There are no known oil and gas deposits or oil seeps, nor have there been any exploration wells drilled in the GRA or the bordering areas.

There are no Federal oil and gas leases in the GRA or vicinity. No serious exploration for petroleum has ever been done in this part of the Basin and Range province due to the absence of petroleum source rocks.

Geothermal Resources

1. Known Geothermal Deposits

   There are no known geothermal deposits in the GRA.

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

   There are no known thermal prospects or occurrences in the GRA or the surrounding area, but the Basin and Range province in this region has many thermal wells and springs. The regional, deep-seated, normal faults and the presence of young volcanics, indicates this is a positive environment for geothermal resources.

3. Geothermal Leases

   There are no geothermal leases in the GRA or the immediate region.

4. Geothermal Deposit Types

   Geothermal resources are hot water and/or steam which occur in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

   The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

   The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults, or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

   Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir, as well as the end use, determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year round mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and crystalization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

Unlike most mineral commodities remoteness of the resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in WSA NV 050-0350. There is no potential at all for coal, oil shale or tar sands.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981 - March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

IV. LAND CLASSIFICTION FOR G-E-M RESOURCES POTENTIAL

The 1:62,500 map of McKee (1968) provides excellent geological coverage of most of the GRA and all of WSA NV 050-0350. Albers and Stewart (1972), Briner (1980), and other authors provide good information on mineral occurrences, and the principal writer of this report, Arhtur Baker III, has examined many prospects in the GRA although not in the WSA. Overall, the quantity of geological data available is excellent and its quality is high. The quantity and quality of data concerning mineral occurrences is good, the only lack being information concerning alteration other than that caused by pyrometasomatism, if there is any, in the WSA. The overall level of confidence in the data available is high.

Land classification areas are numbered starting with the number 1 in each clategory of resources. Metallic mineral land classification areas have the prefix M, 3.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of thhe surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification,, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0350

M1-4C. This classification area covers a small part of the northeast corner of the WSA. Half a mile to the north of the WSA there has been placer gold production from deposits in a wash. Within the WSA there are seven placer claims (in Sec. 30, T 6 S, R 39 E) in another wash. The known placer production nearby, the presence of placer claims in the WSA, and the widespread distribution of placer gold in the washes of the GRA, are the basis for the classification as highly favorable and for the moderate level of confidence in this classification.

M2-3D. This classification area covers a small part of the southern corner of the WSA. In it are the known Les Brown molybdenite deposit (to which a cherry-stem road already leads) and two or three other prospects that are shown on the Magruder Mountin 15-minute topographic quadrangle; one of these prospects is well outside the cherry-stemmed area. The known presence of molybdenite and the indicated rather widespread prospect pits are the basis for the classification as moderately favorable and the high level of confidence in this classification.

M3-1A. This classification area covers the remainder of the WSA. There are no known claims, prospects, or mineral occurrences, which is the reason for the classification of no indication of favorability for mineral resources. The presence of a variety of known mineral resources very close to the WSA to the north, east and south -- silver-lead, placer gold, disseminated molybdenite, pegmatite molybdenite -- is the reason for the low level of confidence in this classification: one or another of them may extend into the WSA.

b. Uranium and Thorium

WSA NV 050-0350

U1-2B. This land classification covers the WSA and the central and southeastern part of the GRA. These areas are covered by Jurassic quartz monzonite, Precambrian and Cambrian sediments and Tertiary basalt. The area has low favorability with a low confidence level for fracture filled and pegmatite-type uranium deposits. The quartz monzonite and associated pegmatites are possible sources for uranium which could have been deposited in fractured quartz monzonite or in fractured sediments marginal to the intrusion. Occurrences of this type, as described above, have been noted in areas to the east of the GRA. Sediment samples with anomalous uranium concentrations (5-10 ppm) have been collected from Cucomungo Canyon and streams draining the Sylvania Mountains (Oak Ridge Gaseous Diffusion Plant, 1981), indicating that the quartz monzonites in the GRA and WSA may be potential uranium sources.

The area has low favorability with a low level of confidence for thorium deposits in pegmatites, associated with Jurassic quartz monzonite.

U2-2B. This land classification covers a small area adjacent to the southeastern edge of the WSA, and parts of the northeast, northwest and southwest portions of the GRA. These areas are covered by Quaternary alluvium. They have a low favorability for epigenetic sandstone-type uranium deposits, especially where the alluvium occurs adjacent to quartz monzonite, as in the small area southeast of the WSA. The quartz monzonite and pegmatites may be a source of uranium which can be leached by ground water and deposited in alluvium adjacent to bedrock areas.

The area has low favorability with a low confidence level for thorium in placer concentrations of heavy minerals derived from weathering of quartz monzonite and pegmatites. A heavy mineral concentration of this type occurs to the east of the GRA in Tule Canyon, indicating that the quartz monzonite and/or pegmatites in the area may be thorium source rocks.

c. Nonmetallic Minerals

WSA NV 050-0350

N1-2B. This classification area covers all of the WSA. There are no known nonmetallic claims, prospects or mineral occurrences, and the quartz monzonite rock type is not a suitable host rock for the talc deposits that are numerous only a couple of miles away. However, any mineral material can be made into an economically produceable nonmetallic mineral if someone can develop a market for it, and any can be used for some construction applications. This is the reason for the classification of low favorabilities with low confidence.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 050-0350

OG1-1D. The entire WSA is underlain by a large Tertiary/Jurassic granitic intrusive, with minor bodies of metamorphosed sediments and some Quaternary/Tertiary age basalt. These rock units are devoid of source beds, and no favorable section is present for the accumulation of oil and gas.

No maps are presented for oil and gas.

b. Geothermal

WSA NV 050-0350

G1-2A. The presence of regional-scale normal faults and young volcanics in the WSA indicates there is the structure, and possibly a heat source present, which would provide the setting for the occurrence of geothermal resources.

c. Sodium and Potassium

WSA NV 050-0350

S1-1D. This classification applies to the entire WSA. There is no indication of favorability for the accumulation of resources of sodium and potassium.

No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been considered in the section on Nonmetallic Minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

No additional work is recommended for WSA NV 050-0350.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

Albers, J. P., 1967, Belt of sigmoidal bending and right-lateral faulting in the western Great Basin: Geol. Soc. America Bull., v. 78, no. 2, p. 143-155.

Albers, J. P., and Stewart, J.H., 1972, Geology and mineral deposits of Esmeralda County, Nevada: Nev. Bur. Mines and Geology, Bull. 78. General geology, some mine and prospect descriptions.

American Bureau of Metal Statistics Inc., 1982,, Non-ferrous metal data - 1981, Port City Press,, New York, New York, p. 133-134.

Briner, W.D., 1980, Geology of part of the Cucomungo area, Esmeralda County, Nevada: Univ. of Nevada, Reno, M.S. thesis. Very detailed geology, some geochemistry, much petrography of a limited area.

Garside, L. J., 1973, Radioactive mineral occurrences in Nevada: Nevada Bur. Mines Bull. 81, 121 p.

Garside, L. J. and Schilling, J. H., 1979, Thermal waters of Nevada: Nevada Bur. of Mines and Geol. Bull. 91.

Garside, L. J., Weimer, B. S. and Lutsey, I. A., 1977, Oil and gas developments in Nevada, 1968-1976: Nevada Bur. Mines and Geol. Rept. 29.

Kirk, William S., 1980a, Thorium in Mineral Facts and Problems, 1980 ed., U. S. Bureau of Mines, Bull. 671,, p. 937-945.

Kirk, William S., 1980b, Thorium in Minerals Yearbook, vol. I, Metals and Minerals, U. S. Bureau of Mines, p. 821-826.

Kirk, William S., 1982, Thorium in Mineral Commodity Summaries - 1982, U. S. Bureau of Mines, p. 160-161.

Kral, V. E., 1951, Mineral resources of Nye County, Nevada: University of Nevada Bull., v. 45, No. 3, Geology and Mining Series, no. 50.

Lintz, J. L., Jr., 1957, Nevada oil and gas drilling data, 1906-1953: nevada Bur. Mines Bull. 52.

McKee, E. H., 1968, Geology of the Magruder Mountain area, Nevada-California: U. S. Geol. Survey Bull. 1251-H. Detailed geology covering WSa NV 050-0350.

Mining Journal, July 24, 1981, vol. 297, No. 7641.

NOAA/National Oceanic and Atmospheric Administration, 1980, Geothermal resources of California: Map prep. by Nat. Geophy. and Solar-Terrestrial Data Center from data compiled by California Division of Mines and Geology, California Geologic Data Map Series, Map No. 4.

Nelson, C. A., 1978, Late Precambrian-Early Cambrian stratigraphy and faunal succession of eastern California and the Precambrian-Cambrian boundary: Geol. Mag. 115(2), 121-126.

Norman, L. A., Jr., and Stewart, R.M., 1951, Mines and mineral resources of Inyo County, California: Calif. Div. Mines, Calif. Jour. Mines and Geology, vol. 47, no. 1.

Nevada Bureau of Mines and Geology Oil and Gas Files, 1982b.

Oak Ridge Gaseous Diffusion Plant, 1981, Hydrogeochemical and stream sediment reconnaissance basic data for Goldfield Quadrangle, Claifornia, Nevada: U. S. DOE Grand Junction Office, open file report GJBX-418(81) 83 p.

Papke, K. G., 1975, Talcose minerals in Nevada: talc, chlorite and pyrophyllite: Nev. Bur. Mines and Geol. Bull. 84. Description of Sylvania and Palmetto talc districts and mines therein.

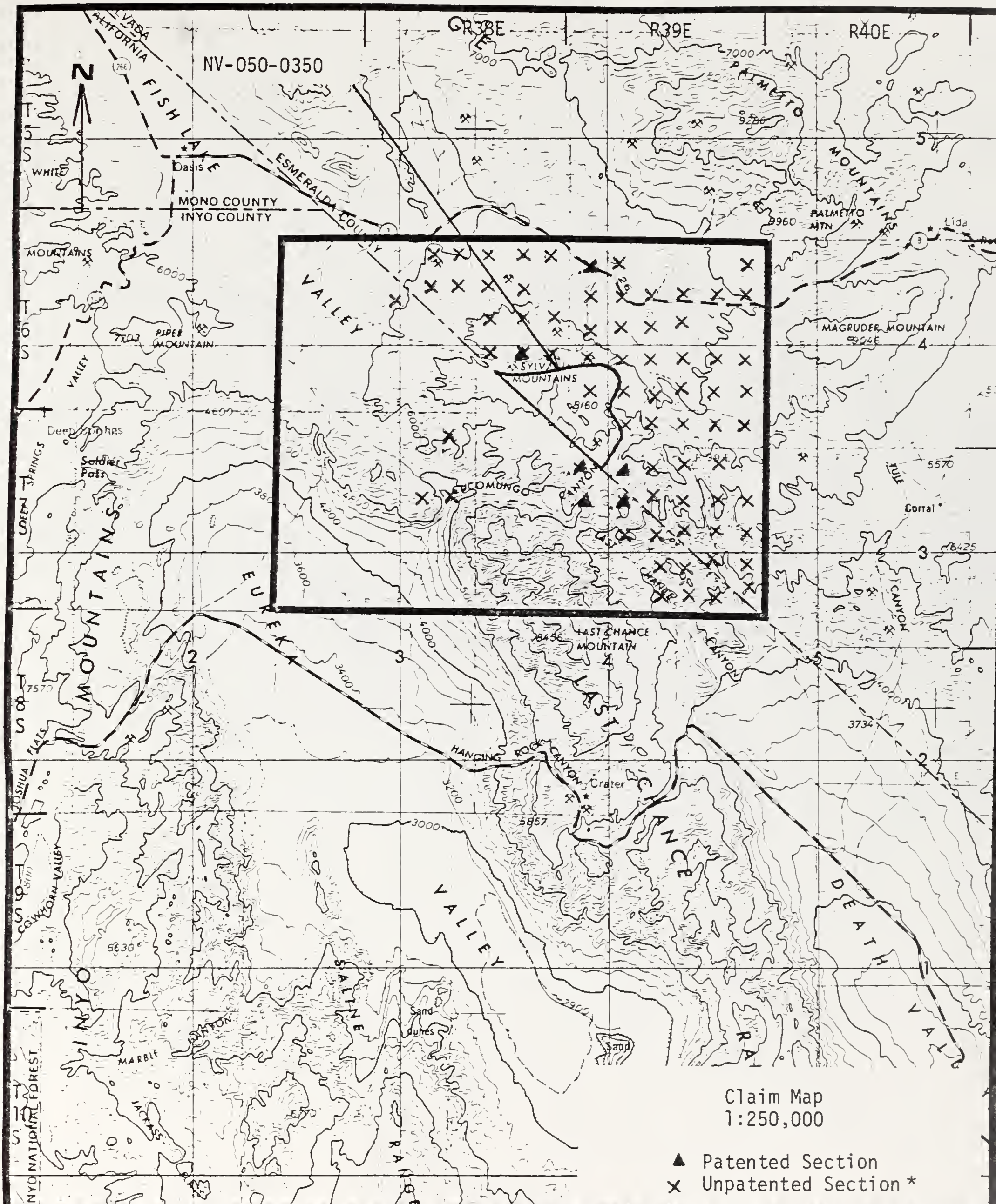
Papkeada K. G., 1979, Fluorspar in Nevada: Nevada Bur. Mines and Geol. Bull. 93. In this GRA, only Amry fluorspar prospect is described.

Schilling, J. H., and Garside, L. J., 1968, Oil and gas developments in Nevada 1953-1967: Nevada Bur. Mines and Geol. Rept. 18.

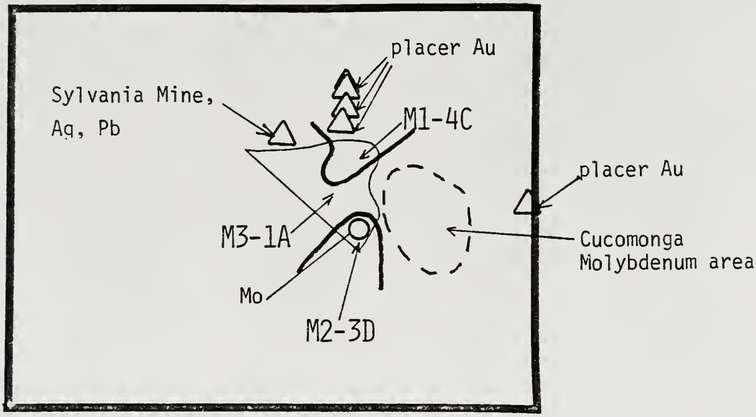
Stewart, J. H., 1980, Geology of Nevada - a discussion to accompany the geologic map of Nevada: Nevada Bur. of Mines and Geology Spec. Pub. 4.

Stewart, J. H., and Carlson, J. E., 1978, Geologic map of Nevada: U. S. Geol. Survey in cooperation with Nevada Bureau of Mines and Geology.

Strand, R. G., 1967, Mariposa sheet of the geologic map of California: Calif. Div. Mines and Geology.



*X denote one or more claims per section



EXPLANATION

- - - - Mining District, commodity

△ Mine, commodity

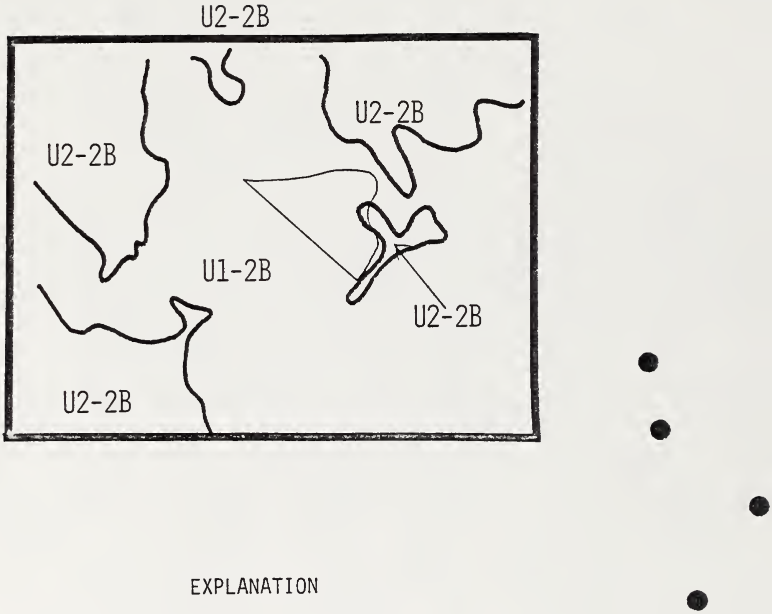
○ Occurrence, commodity

━━ Land Classification Boundary

—— WSA Boundary

Pigeon Spring GRA NV-20
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Metallics



EXPLANATION

● Uranium Occurrence

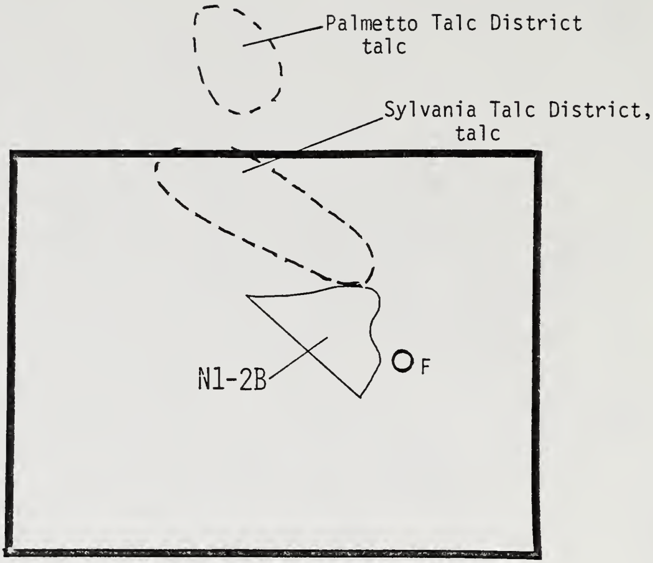
▬ Land Classification Boundary

— WSA Boundary

Pigeon Spring GRA NV-20

Scale 1:250,000

Land Classification - Mineral Occurrence Map/Uranium



EXPLANATION

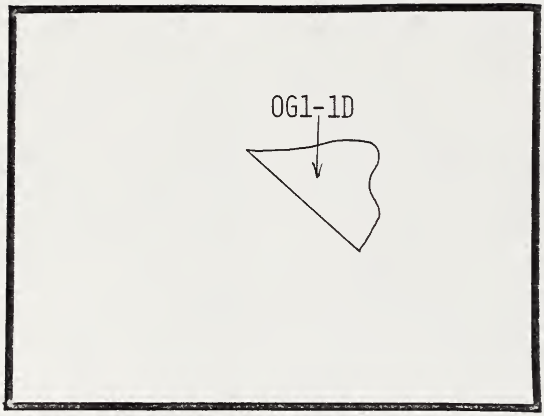
- - - Mining District, commodity

O Occurrence, commodity

—— WSA and Land Classification Boundary

Pigeon Spring GRA NV-20
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Nonmetallics

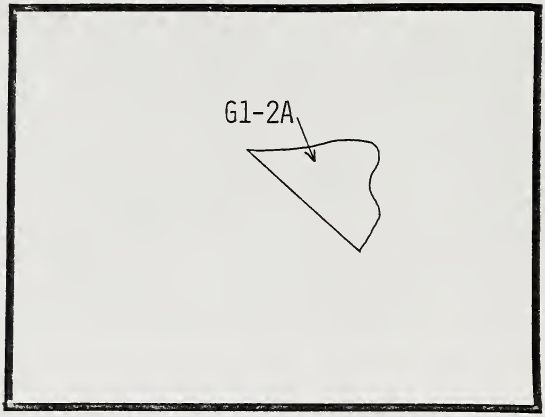


EXPLANATION

—— WSA and Land Classification Boundary

Pigeon Spring GRA NV-20
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Oil and Gas



EXPLANATION

—— WSA and Land Classification Boundary

Pigeon Spring GRA NV-20
Scale 1:250,000

Land Classification - Mineral Occurrence Map/Geothermal

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [4]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600 + [3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene, and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970